

**Coatings Technology Handbook, Second Edition**, edited by D. Satas and Arthur A. Tracton, Marcel-Dekker, Inc., New York, 2001, 902 pp., ISBN: 0-8247-0439-8, \$225.00

**REVIEWED BY: ANTHONY J. RAFANELLI<sup>1</sup>**

D. Satas and Arthur Tracton have undertaken a very broad task of gathering an abundance of information on coatings and compiling it in one reference work. They have done a very good job in organizing a chapter authors roster that spans the industrial world, i.e., those who produce coatings, those who use them, and those who evaluate them. The book is comprised of one hundred four (104) chapters organized into four (4) parts as follows: Fundamentals and Testing, Coating and Processing Techniques, Materials, and Surface Coatings. For brevity, reviews and comments are made on only several of the chapters in each part.

Within Part 1 (Fundamentals and Testing), Chapter 1, written by Dr. Ken Gilleo, discusses rheology and surface chemistry. As during his conference presentations, Ken provides the same level of enthusiasm in this section of the book. He provides a very broad based definition of rheology to which even this reviewer was not aware. He provides very effective definitions of key properties including a very reader-friendly description of surface tension and contact angle. Viscosity is also addressed with mention of temperature and solvent effects as well as measurement techniques. This chapter serves very well as the anchor for the rest of the book. In Chapter 5, Carl Dahlquist does a very good job of presenting the theory of adhesion. Continuing with contact angle, the author illustrates the relationship between this parameter and surface tension. Young's original and modified equations are discussed. Included also is mention of forces of attraction including the "London" forces. The chapter ends with explanations of real and ideal adhesive bond strengths. Chapter 6, written by Ulrich Zorli, focuses on adhesion testing. This chapter is very comprehensive and includes fundamentals of adhesion, standard adhesion tests, delamination procedures, local debonding systems, and flaw detection methods. The chapter serves as an excellent resource for the laboratory engineer or technician. Chapter 7, written by Arthur Tracton, looks at coating calculations. Coatings are defined as a mixture of four materials: resins, pigments, solvents, and additives. Included are calculations for many formulation parameters such as density, non-volatile weight, bulking factor, and others. The remaining seven chapters (8 through 14) deal with infrared spectroscopy, thermal analysis color measurement, use of X-ray fluorescence, sunlight/ultraviolet/weathering effects, cure monitoring, and test panels. Regarding cure monitoring, Chapter 13 discusses use of micro-dielectric techniques. In short, cure is monitored based on dielectric responses during the process. Interestingly, Chapter 14 focuses on test panels (coupons) which tend to be taken for granted. However, there is a certain level of discipline involved in generating proper samples to ensure maximum effect in evaluating critical properties such as adhesion, corrosion resistance, and appearance. The chapter does well to reiterate the care that needs to be taken in working with these test samples.

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Part 2 contains twenty-seven chapters (15–41) addressing the top-level category of Coating and Processing Techniques. These include wire-wound rod coating, slot die coating, extrusion coating, porous roll coater, rotary screen coating, screen printing, flexography, ink jet printing, electrodeposition of polymers, electroless plating, electroplating chromium, armology chromium process, sputtered thin film coating, reactive plasma deposition and etching, cathodic arc plasma deposition, industrial diamond and diamond-like films, tribological synergistic coatings, chemical vapor deposition, solvent vapor emission control, surface treatment of plastics, flame surface treatment, plasma surface treatment, surface pre-treatment, calendaring of magnetic media, embossing, in-mold finishing, and high-volume, low pressure finishing. Chapters 20 and 22, dealing with screen and ink-jet printing, are well written and clearly explain these important processes. Chapter 24 discussed electroless plating. Features of the discussion include 1) a good comparison of electroless versus electroplating techniques, 2) concise explanation of systems and solutions, and 3) useful section on practical applications. Chapters 25 and 26 deal with chromium processes while Chapter 27 addresses sputtered thin film coatings. Chapter 31 centers around synergistic coatings which, interestingly enough, are not true coatings but serve as products of multi-step processes that combine advantages of anodizing with controlled infusion of polymer and/or dry lubricant. Such "coatings" greatly improve tribological properties of a surface. Included in the chapter is a chart containing friction data of several engineering materials. Chapter 32 deals with chemical vapor deposition (CVD) including some very good photographs showing practical applications. Chapter 34 discusses surface treatment of plastics. This is a very timely topic to include. Plastics and other polymers are greatly influencing today's advanced technologies and surface treatment of these materials is critical for bonding and general protection requirements. This is a very thorough chapter presenting information on functions of surface preparation, factors impacting preparation, preparation techniques, and evaluative approaches.

Part 3 provides thirty-four chapters (42–75) on materials used as coatings. Some of the topics discussed are acrylic polymers, vinyl ethers, polystyrene, liquid polymers, polyesters, alkyd resins, polyurethanes, phenolics, coal tar, thermoplastics, polyvinyl chloride, polyimides, and polyaryxylyene (PARYLENE™). Chapter 42 discusses acrylic polymers and includes a section on application areas for this material. In addition, information is given on this material in several functional roles such as adhesive, ink, and coating. Chapter 58 focuses on polyaryxylyene (PARYLENE™). While informative, the chapter was disappointingly short and could have been enhanced by photographs of products using this coating approach. One other comment regarding Part 3 pertains to the property of moisture permeability. Since one key purpose for using coatings is to retard moisture penetration, one would expect to see such data or at least qualitative evaluations of these materials with respect to moisture ingress. Very little of this information was obvious in these chapters.

Part 4 consists of twenty-nine (29) chapters dealing with flexographic inks, multicolor coatings, paintings conservation varnish, thermoset powder coatings, peelable medical coatings, conductive

coatings, silicone release coatings, silicone hard coatings, pressure sensitive adhesives, self-seal adhesives, sol-gel coatings, radiation cured coatings, nonwoven fabric binders, fire-retardant/fire-resistant coatings, leather coatings, metal coatings, corrosion-control coatings, marine coatings, decorative surface protectors, coated fabrics, architectural fabrics, gummed tape, transdermal drug delivery systems, optical fiber coatings, exterior wood finishes, pharmaceutical tablet coatings, textile coatings, and non-wovens. Obviously, this section is extremely comprehensive. This reviewer chose to concentrate on the following chapters: 81-Conductive Coatings, 82-Silicone Release Coatings, and 92-Corrosion and its Control by Coatings. Chapter 81 does a very good job of summarizing these types of materials. The types of coatings discussed are metallic, filled polymeric, polymeric (inherently conductive), and organo-metallic. The author excels at comparing filled polymer with inherently conductive polymer, which would benefit subsequent trade studies. Also, some applications are highlighted in which the use of these materials is related to stealth technology. Chapter 82 features silicone-release coatings and includes data on release and cure characteristics. Chapter 84 focuses on pressure sensitive adhesives (PSAs) and provides information on developmental history, adhesive proper-

ties, and product applications. Chapter 92 stands out as one of the best chapters in the entire book. The author (Clive H. Hare) does an excellent job of combining a suitable amount of text and graphics to explain the basic principles of the corrosion mechanism. Kudos to the author for providing an effective graphical approach in explaining cathode size effects regarding corrosion severity. Information on types of coatings, i.e., barrier, inhibitive, and zinc-rich, provide a good basis for designers to approaches in mitigating corrosion effects.

The list of contributing authors (chapter authors) is very impressive and provides an excellent cross-section of expertise from the industrial and academic communities. The organization is well done providing four major parts focusing on the top level topics previously mentioned. The book's greatest strength may also be a reason for one to become overwhelmed, i.e., the book is extremely thorough in providing detailed information on not just coatings but many material systems that comprise the coatings. It may take some effort for a reader to find the information he/she is interested in obtaining. However, this reviewer does not consider this a shortcoming; rather it is a credit to the general editors that they chose to provide a comprehensive work. The book is an excellent reference and is recommended for any engineer's library.